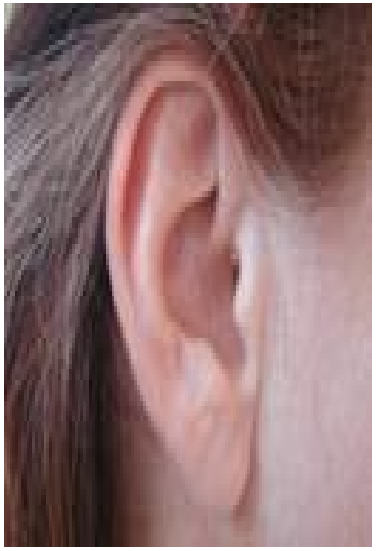
HEARING CONSERVATION PROGRAM

EAR ANATOMY and PHYSIOLOGY



28 Jan 2013

LEARNING OBJECTIVES

1. **Identify the basic anatomical and functional divisions of the ear**
2. **Describe the basic anatomical and functional structures of each division**
3. **Summarize how sound travels through the ear and is transmitted to the brain**

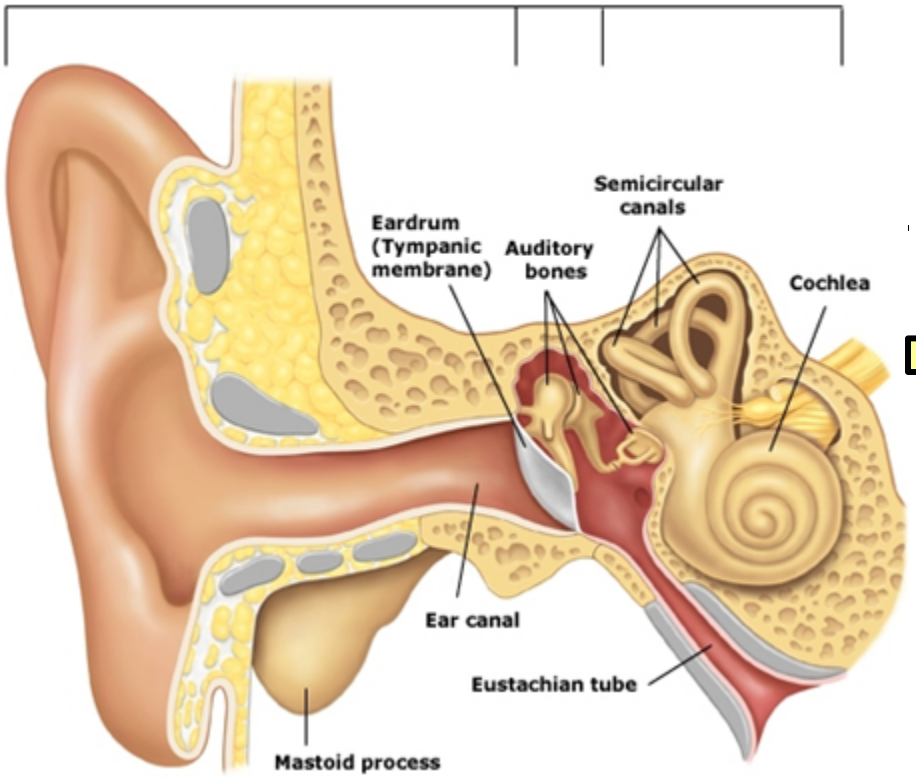
4 DIVISIONS OF THE EAR

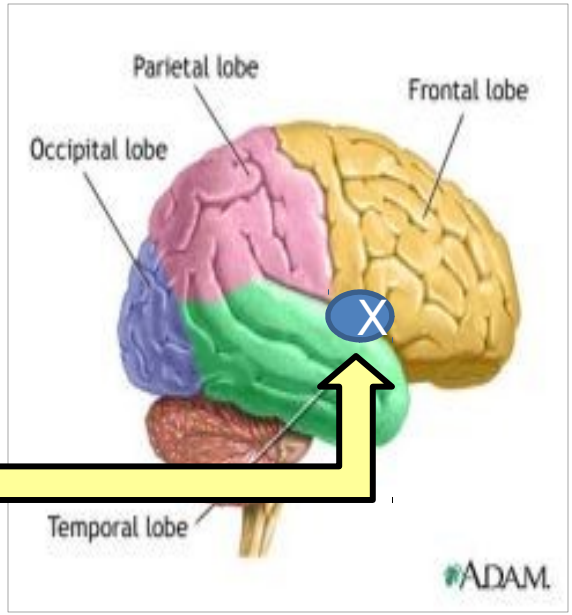
Outer

Middle

Inner

Central





DIVISION #1: OUTER EAR

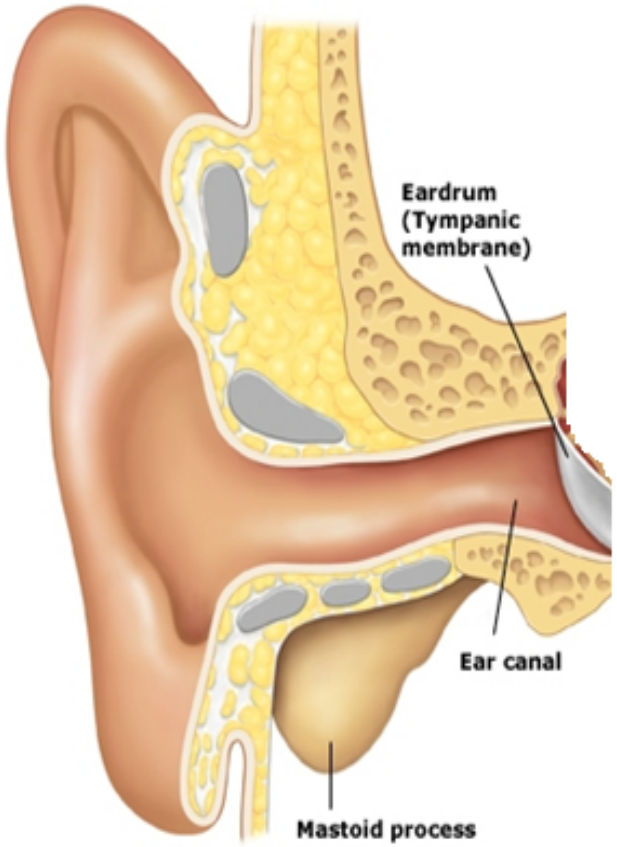
Pinna or Auricle

- Visible part
- Sound collector
- Sound amplifier
- Location of sound

External Auditory Canal

- Cartilage and bone
- Channels sound
- Protects eardrum

Note: Mastoid Bone "behind" outer ear



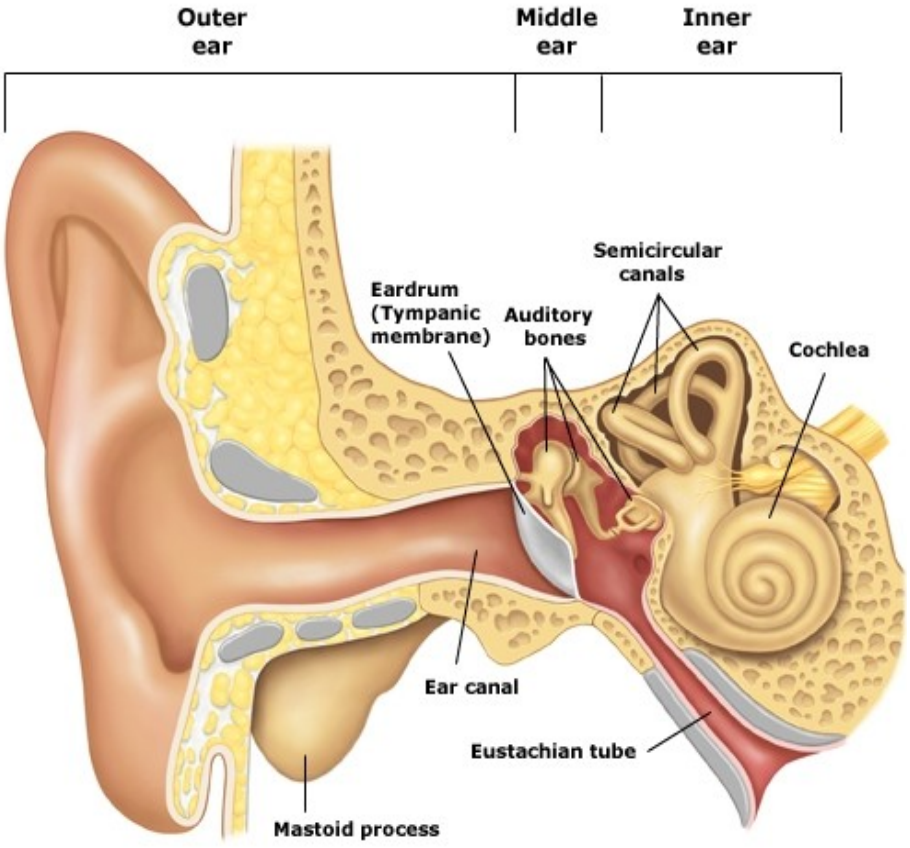
Division #1
Outer Ear cont…

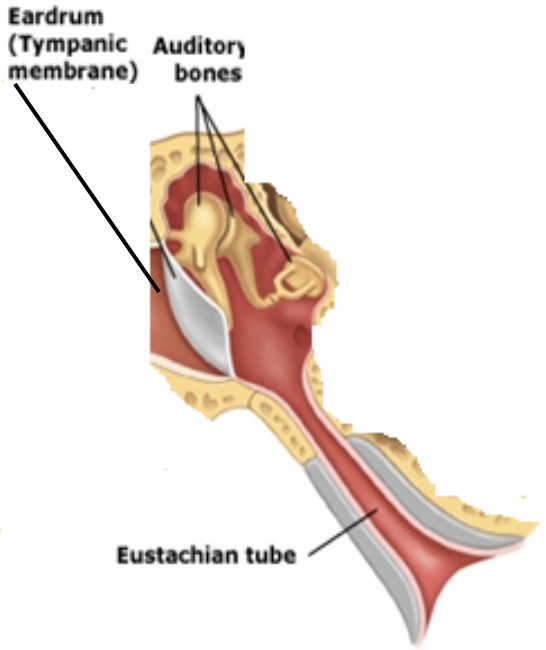
Cerumen or ear wax
(and hair)

Normal
Protects
Color varies – age/race

OHC Technician concerns: too much cerumen
for accurate hearing test and fitting HPDs

DIVISION #2: MIDDLE EAR





Division #2
Middle Ear cont…

Tympanic Membrane

(eardrum)

Vibrates

Very sensitive

Converts sound energy

acoustic

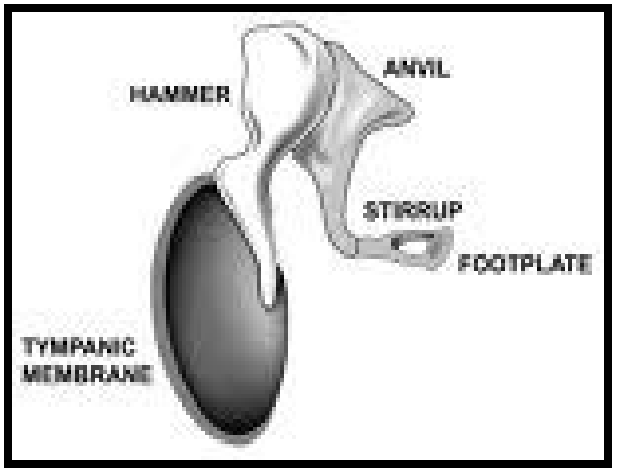
↓

mechanical

Division #2
Middle Ear cont…

Ossicles – 3 bones

- Connects eardrum to inner ear
- Matches impedance
- Amplifies sound energy 50-60dB



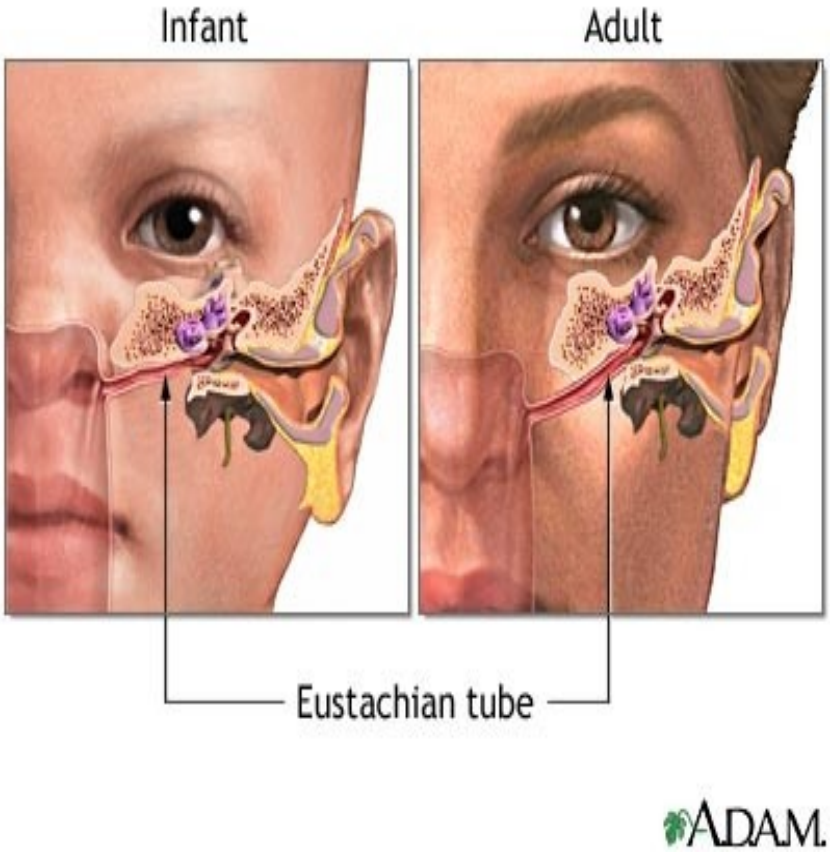
Division #2
Middle Ear cont…

Eustachian Tube

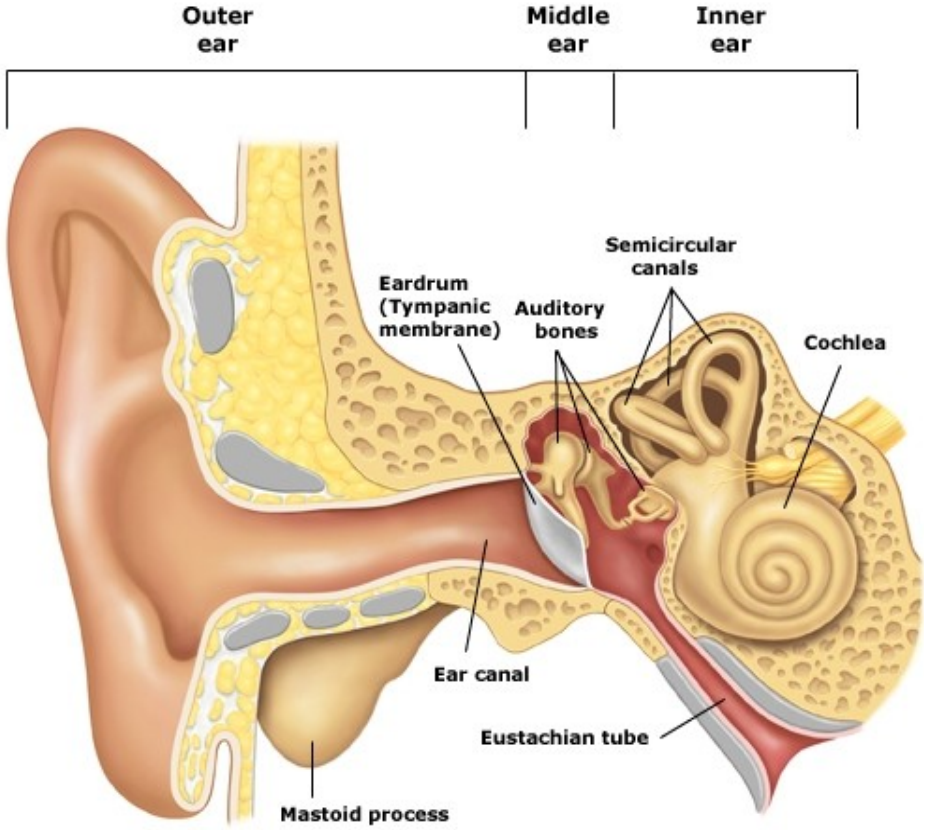
“THE EQUALIZER”

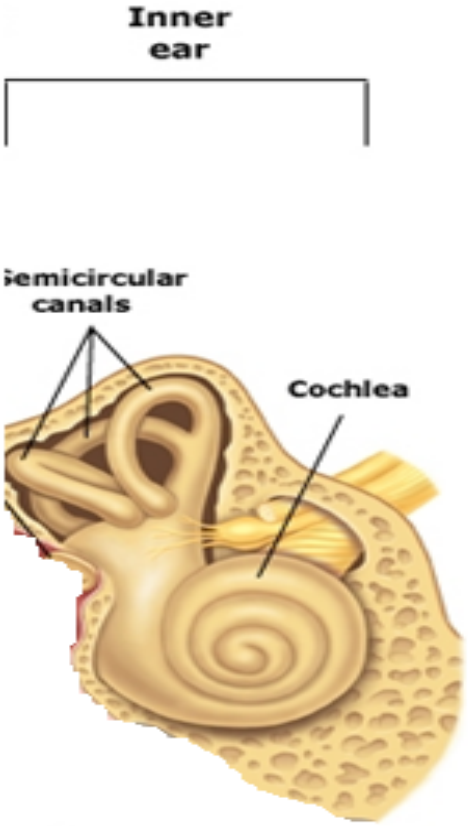
HEALTHY EAR

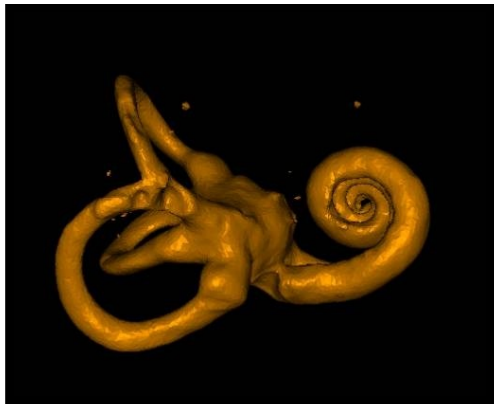
allows air into middle ear space



DIVISION #3: INNER EAR







Division #3
Inner Ear cont…

Inner Ear
fluid

Cochlea
hearing

Oval & Round Windows

Organ **of** Corti

Sensory "Hair" Cells

Vestibular System
balance

Semicircular Canals

Division #3
Inner Ear cont…

Cochlea

Organ of Corti – inner tube

Orderly sensitivity

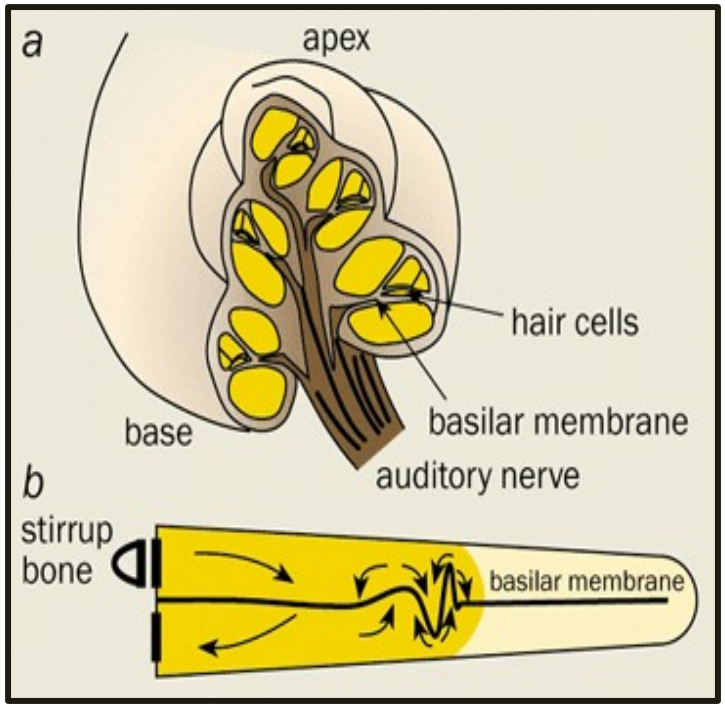
High Hz – base

Low Hz -- tip

Converts sound energy

mechanical-hydraulic

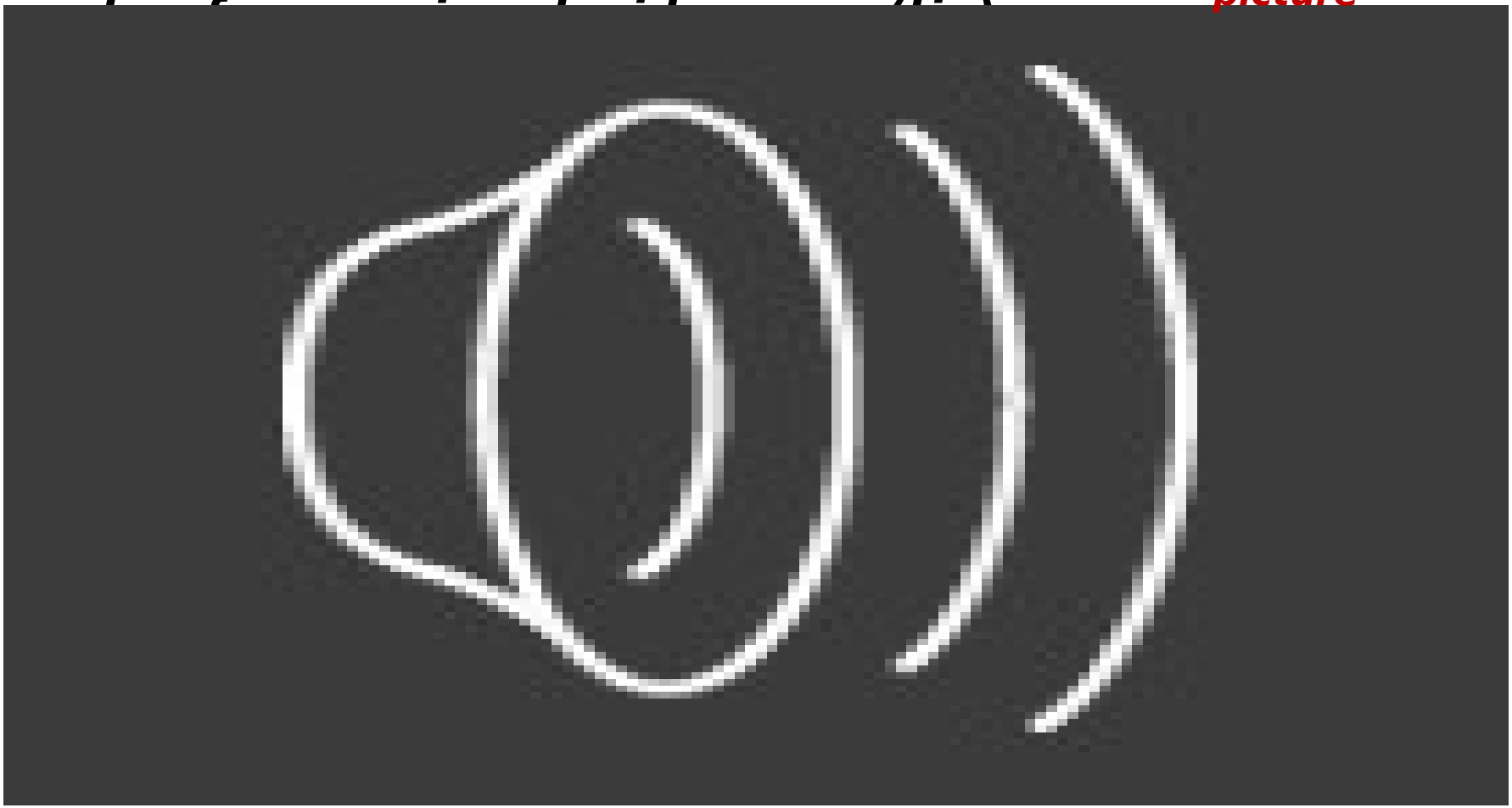
electrical



Frequency Sensitivity in the Cochlea

high frequencies at narrow base (opening)

Click on picture



Division #3
Inner Ear cont…

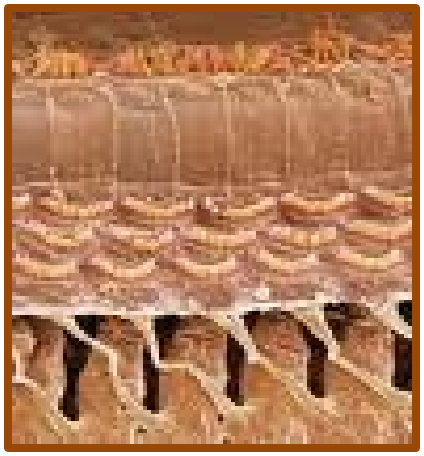
Organ of Corti

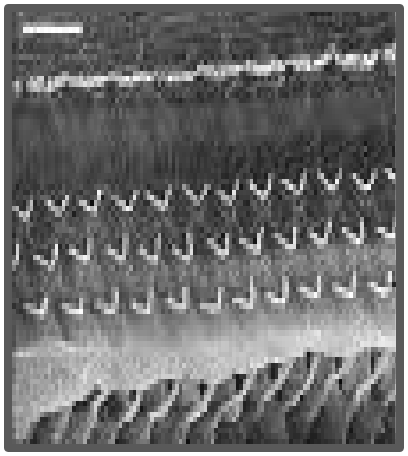
Outer Hair Cells

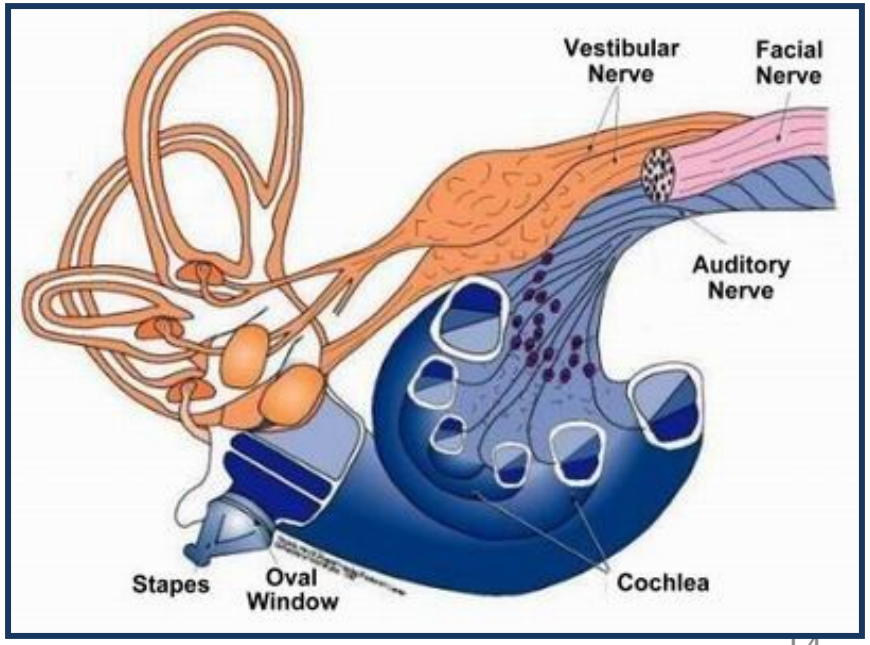
- **mechanically amplifies low intensity frequencies**

Inner Hair Cells

- **relays amplified frequencies to nerves**



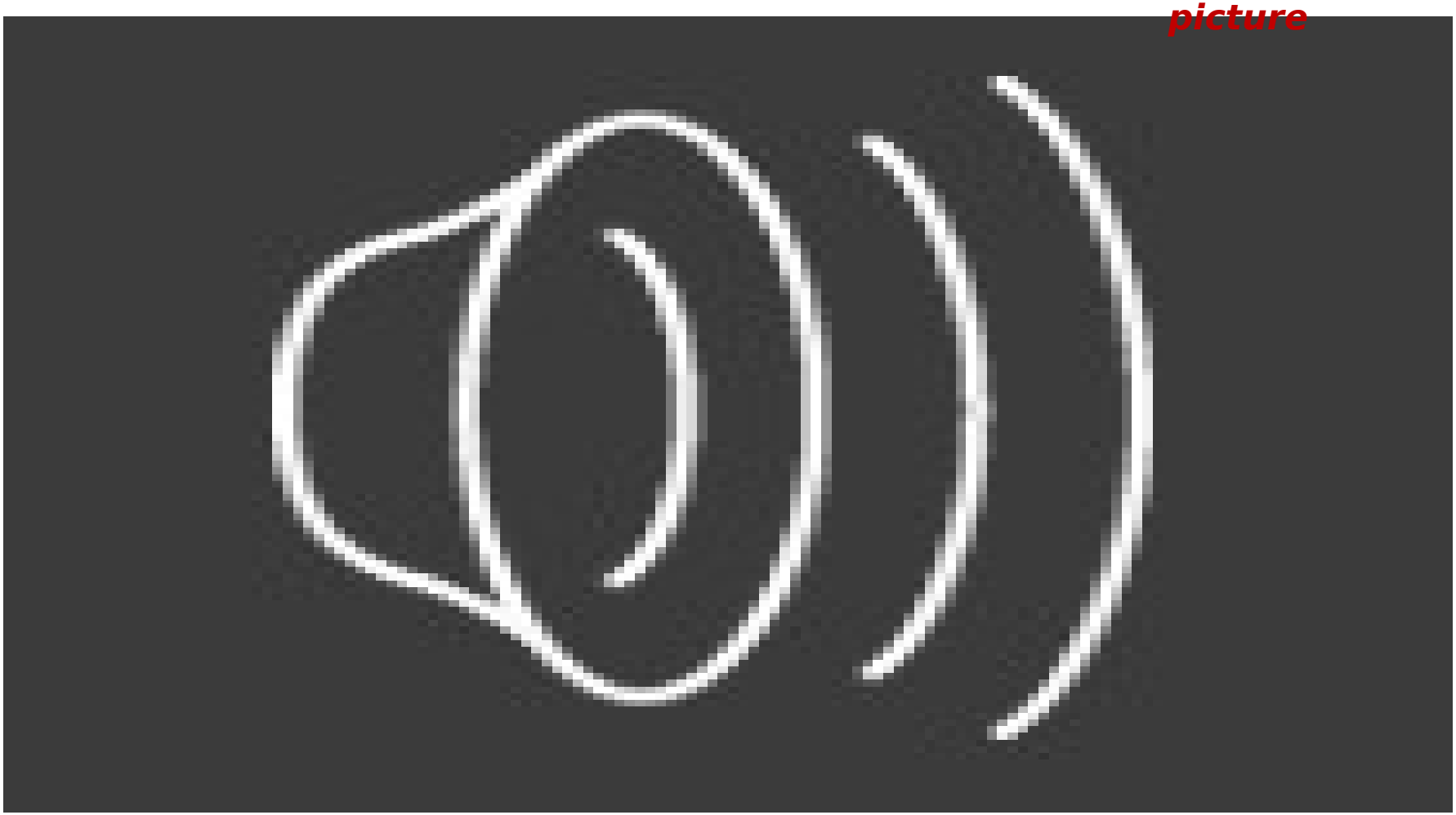




Dancing Outer Hair Cell

an individual hair cell is responding to its particular intensity/frequencies within the music

Click on picture

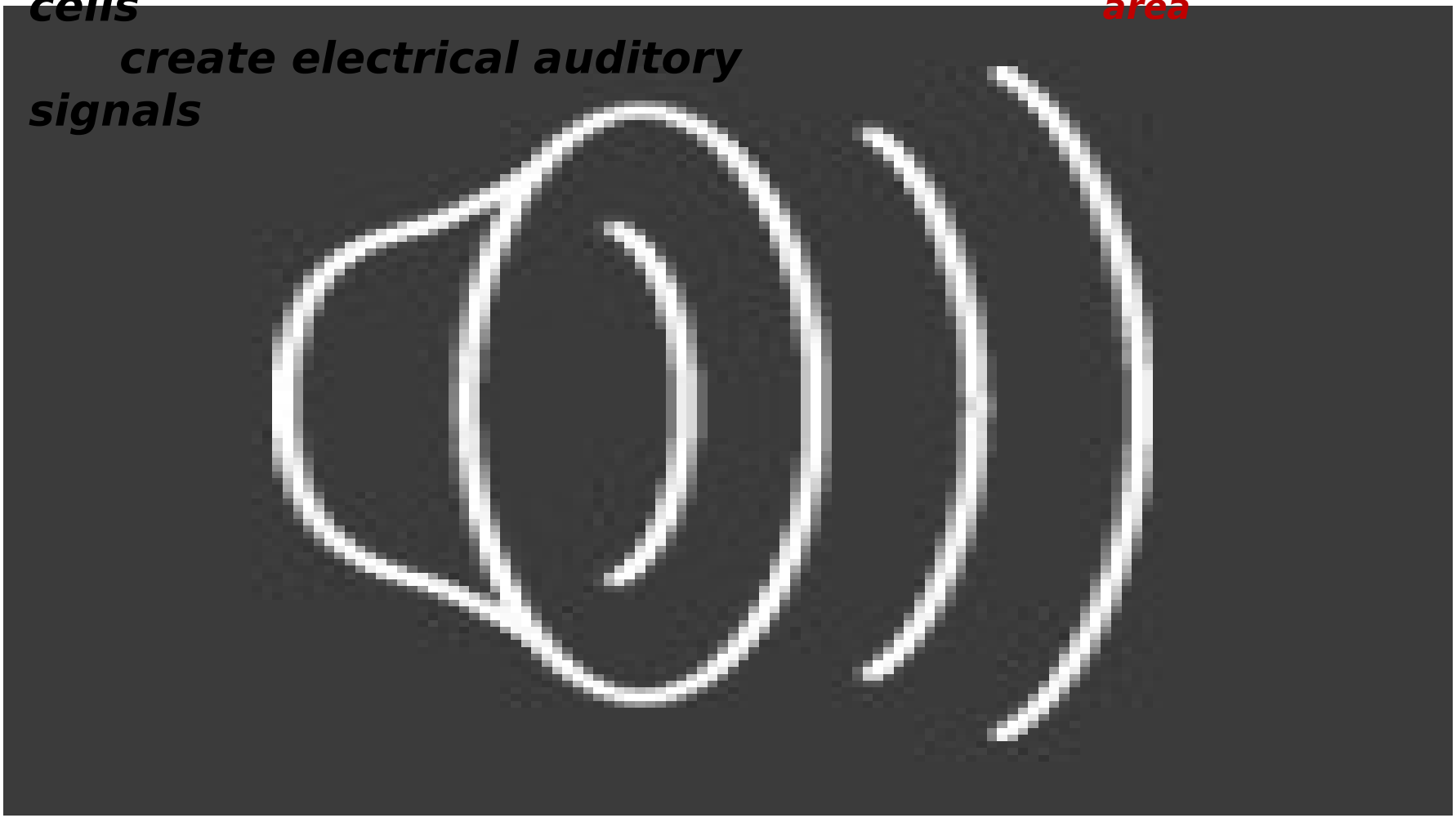


Organ of Corti & Hair Cells

Mechanical movement of hair cells

create electrical auditory signals

Click on black area



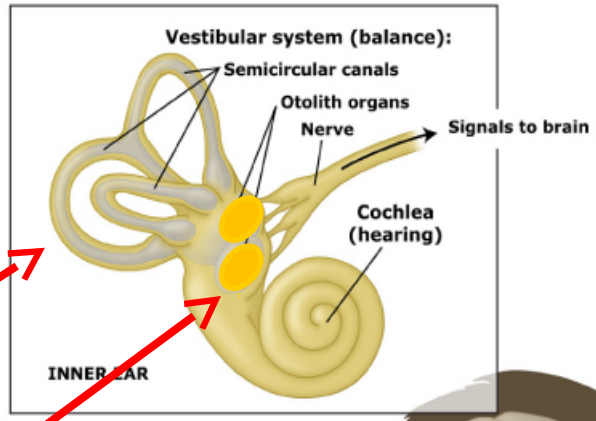
Division #3
Inner Ear cont…

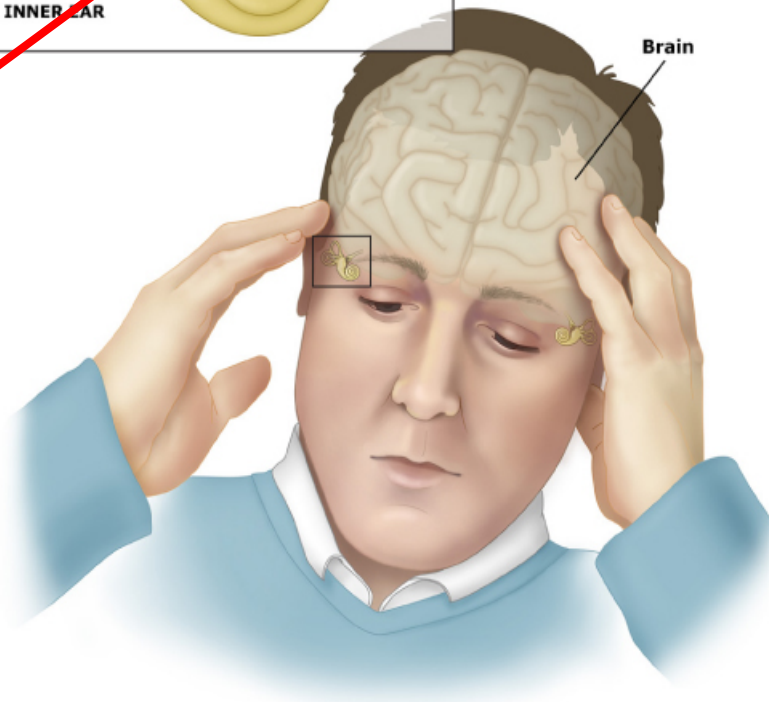
Vestibular System

Balance and sense of orientation in space

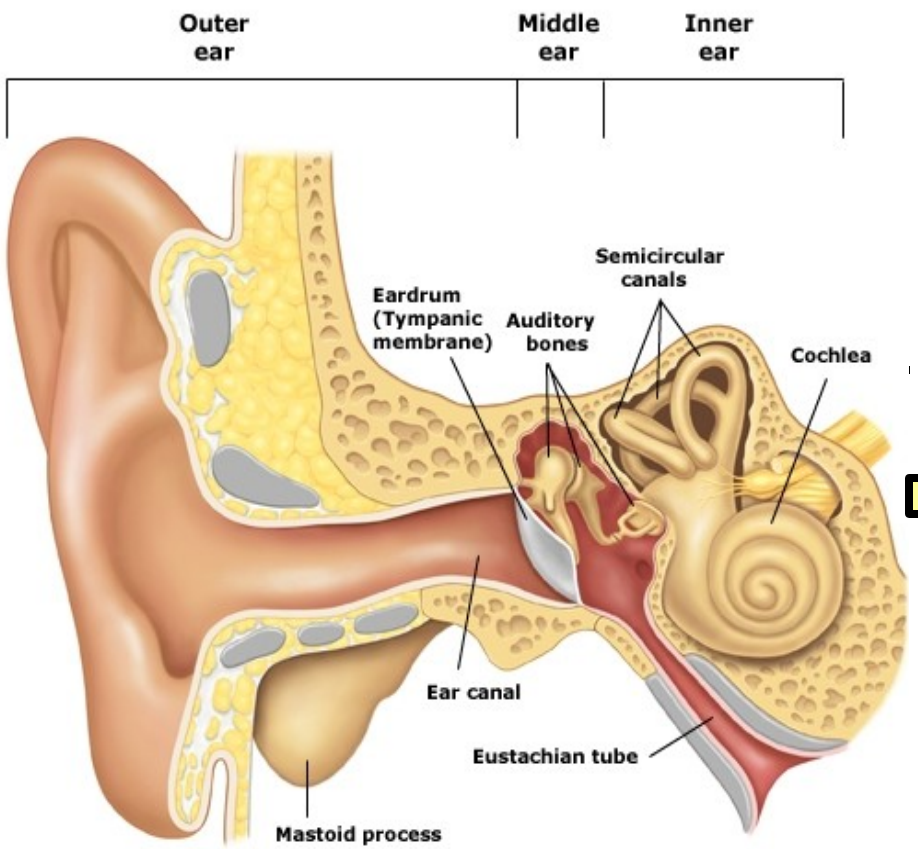
Semicircular canals
- **rotational movements**
  - **twisting/turning**

Otolith system
- **linear movements**
  - **up – down**
  - **left - right**

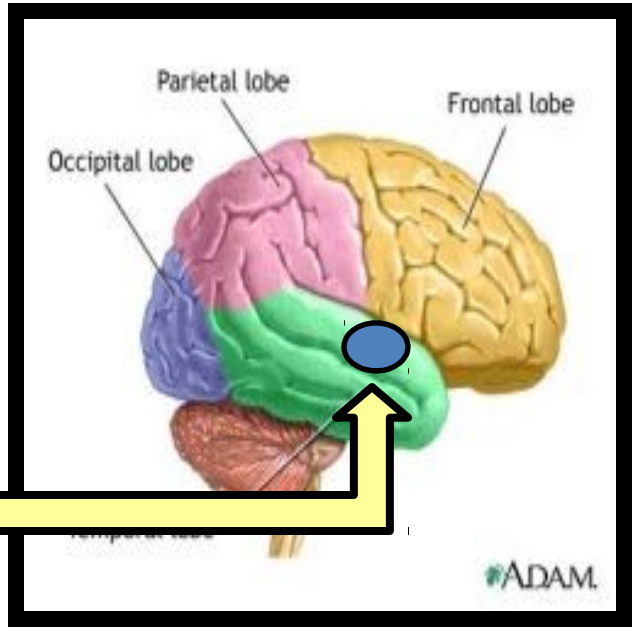




DIVISION #4: CENTRAL AUDITORY SYSTEM



Central ear



Division #4:
Central Auditory System cont…

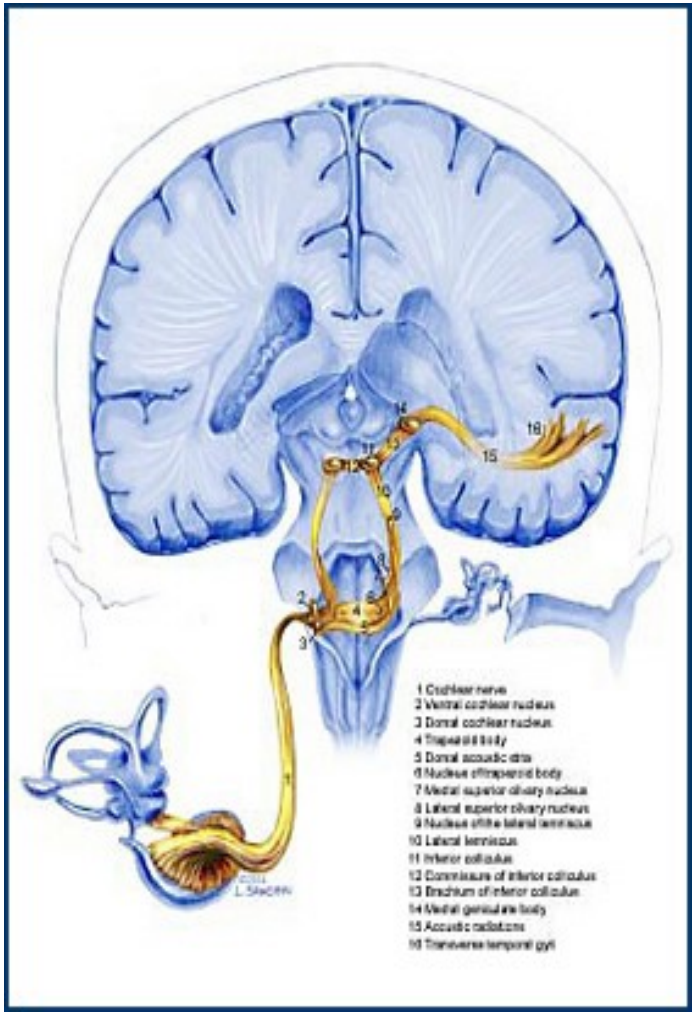
Auditory Nerve (VIII)

Brainstem Auditory Pathways

Auditory Cortex

processing…
analyzing….
interpreting….

Ah ha! I heard "Take Cover!"



How Sound Travels Through the Ear…

1. Pinna
2. Ear Canal
3. Eardrum
4. Ossicles
5. Cochlea
6. Organ of Corti
7. Hair Cells
8. Auditory Nerve
9. Brainstem
10. Brain

ENERGY

Outer ear
Acoustic

↓

Middle ear
Mechanical

↓

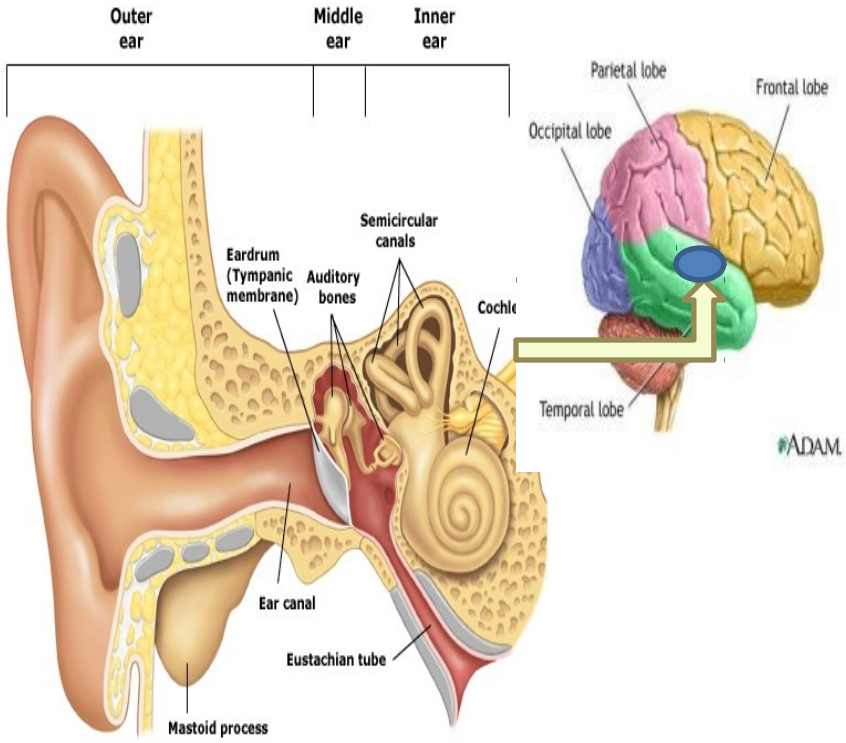
Inner ear
Hydraulic-Electrical

↓

Central ear
Electrical

↓

"Meaning"
Comprehension



QUESTIONS ?

Wait for animation